Adjusted Czech, Hungarian and Slovak Fertility Rates Compared with the Traditional Total Fertility Rate*

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In this paper the Czech, Hungarian and Slovak fertility trends are compared between 1970 and 2011, using four different fertility rates. Three of them are calculated period fertility indicators (traditional total fertility rate, Bongaarts–Feeney tempo- and parity-adjusted total fertility rate, Kohler–Ortega tempo- and parity-adjusted total fertility rate), while the fourth measure is the observed completed cohort fertility rate. It is demonstrated that between 1990 and 2011 the adjusted fertility numbers were higher than the total fertility rate in all three countries, but they didn't reach the replacement fertility level. By comparing the period and completed cohort fertility rates, the most accurate fertility indicator is selected. The authors state that until 1977 (while the mean age of women at the birth of their first child decreased in the Czech Republic and Hungary (but not in Slovakia)), the Kohler-Ortega adjusted fertility rates performed best for the first parity, but for the second and third birth orders and from the mid-1970s for of all birth orders the Bongaarts–Feeney adjusted fertility rates gave closer approximation of the completed cohort fertility in each of the countries.

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The systematic analysis of fertility trends has become part of the scientific research since the second third of the 20th century. Contrary to the theory of overpopulation by *Malthus* [1798], nowadays the main problems are the low number of live births and the decreasing population in developed countries (*Neyer* [2013]). In certain cases – for example when calculating primary school places – it is enough to define the number of new-borns. However, during longer periods and in complex economic analyses – in studying, for example, the sustainability of the pension system or the human factors of the economic growth – we must pay attention to the indicators of fertility rates as well. Up to now the most widely used traditional indicator for measuring period fertility has been the so-called TFR[1] that might provide misleading estimate of a woman's average number of children (*Rallu–Toulemon* [1994]; *Bongaarts–Feeney* [1998], [2004], [2006], [2010]; *Kohler–Ortega* [2002]; *Yamaguchi–Beppu* [2004]; *Goldstein–Sobotka–Jasilioniene* [2009]; *Sobotka–Lutz* [2011]; *Bongaarts–Sobotka* [2012]; *Berde–Németh* [2014]).

This indicator can estimate the fertility properly if the parity composition of women of reproductive age, the timing of childbirth and the distribution of women upon other demographic characteristics are unchanged. However, in periods during which women's mean age at the birth of their child increases, the TFR may be biased. Many authors have pointed out that decreases/increases in the TFR can be attributed to the so-called tempo effect[2] (*Philipov–Kohler* [2001], *Kohler–Billari–Ortega* [2002], *Husz* [2006], *Goldstein–Sobotka–Jasilioniene* [2009], *Frejka et al*. [2011], *Sobotka–Lutz* [2011], *Bongaarts–Sobotka* [2012], *Faragó* [2012], *Berde–Németh* [2014]) that is partly responsible for the drop of the Hungarian TFR, too, which has occurred since the 1980s. However, young women haven't completely forgone childbirth (*Spéder* [2006], *Spéder–Kamarás* [2008], *Pongrácz* [2011], *Szalma* [2011], *Kapitány–Spéder* [2012], *Kamarás* [2012]), at older ages at least some of them try to realize their childbearing intentions, causing some increase in the TFR (tempo effect).

First *Ryder* [1956], [1964], [1980] drew attention to the tempo effect in the middle of the last century. Since then several fertility indicators have been constructed to calculate the average number of live-born children per woman with adjustment for tempo effect (*Bongaarts–Feeney* [1998], [2004], [2006]; *Kohler–Ortega* [2002], *Yamaguchi–Beppu* [2004]). However, besides tempo effect, the estimation of fertility using cross-section data to determine the fertility behaviour of

[1] TFR: total fertility rate.

[2] The tempo effect is a tempo distortion in the value of TFR because of the change in the period mean age of the women at childbearing (*Bongaarts–Sobotka* [2012]).

females over their whole reproductive age span has other pitfalls, too. These drawbacks depend on the changes in data structure and its variation over time. The newest fertility indicators not only correct the tempo effect but also pay attention to the parity composition of the female population (*Kohler–Ortega* [2002]; *Bongaarts–Feeney* [2004], [2006]; *Yamaguchi–Beppu* [2004]).

The various fertility indicators give different pictures about a country's fertility trend. The difference between them may be up to 40 percent or more. (See *Berde–Németh* [2014] Figure 6.) Thus, it is hard to decide which fertility indicator would serve best. By comparing the CFR[3] with the calculated period fertility rates, we may obtain an estimate of these measures' performance.

Besides studying the methodological issues in the context of various fertility rates, the focus of this paper is on the description of the Hungarian fertility trend. It is analysed by comparing the fertility series of Hungary to those of the Czech Republic and Slovakia, because the history and economy of these Central-European countries – which are all members of the so-called "Visegrád" Group[4] – are very similar. We reveal that fertility indicators calculated by using different methodologies and the CFR vary analogously in the three countries. The time series of fertility rates indicate that in the last two decades fertility declined in each of the three countries, and the situation is the most critical in Hungary. However, even the lowest Hungarian adjusted fertility values are higher than the traditional TFR.

Our paper consists of three parts. First, we compare the Czech, Hungarian and Slovak fertility trends using TFR, TFRp*[5] and PATFR*[6] [2002]. It is also demonstrated that the differences between the three main fertility indicators are similar in each country, except for the very beginning of the period observed. Second, we analyse the relationship of the completed cohort and the two corrected fertility rates. Finally, we draw conclusions and identify the areas requiring further research.

1. Hungarian, Czech and Slovak fertility trends from the 1970s

The Czech Republic, Hungary and Slovakia have many similarities not only in their history and development (*Matysiak* [2011]) but also in their fertility trends (*Sobotka*

[3] CFR: completed cohort fertility rate. It shows the average number of children given birth to by women of a cohort during their reproductive life course. The measure can only be calculated when the women in the cohort finish their fertile life.

[4] Due to the lack of data, Poland, the fourth Visegrád country was excluded from the analysis.

[5] TFRp*: tempo- and parity-adjusted fertility rate (*Bongaarts–Feeney* [2004], [2006]).

[6] PATFR*: parity- and age-adjusted fertility rate (*Kohler–Ortega* [2002]).

[2003a], *Goldstein–Sobotka–Jasilioniene* [2009], *Berde–Németh* [2014]). Figure 1 shows three fertility rates (TFR, PATFR*, TFRp*), the MAB[7] and its change[8] for the 1970–2011 period. (For PATFR* and TFRp* figures, see Appendix 1.)

As the upper graphs of Figure 1 show, in the beginning of the 1970–2011 period (except for a few years) the TFR had the highest values among the three indices in each of the three countries. Then the Hungarian, Czech and Slovak TFRs dropped below the two adjusted period fertility rates in 1981, 1983, 1986 respectively and (except for the 1990 Slovak data) remained the lowest. In each country the PATFR* and TFRp* curves approached each other over the whole period.

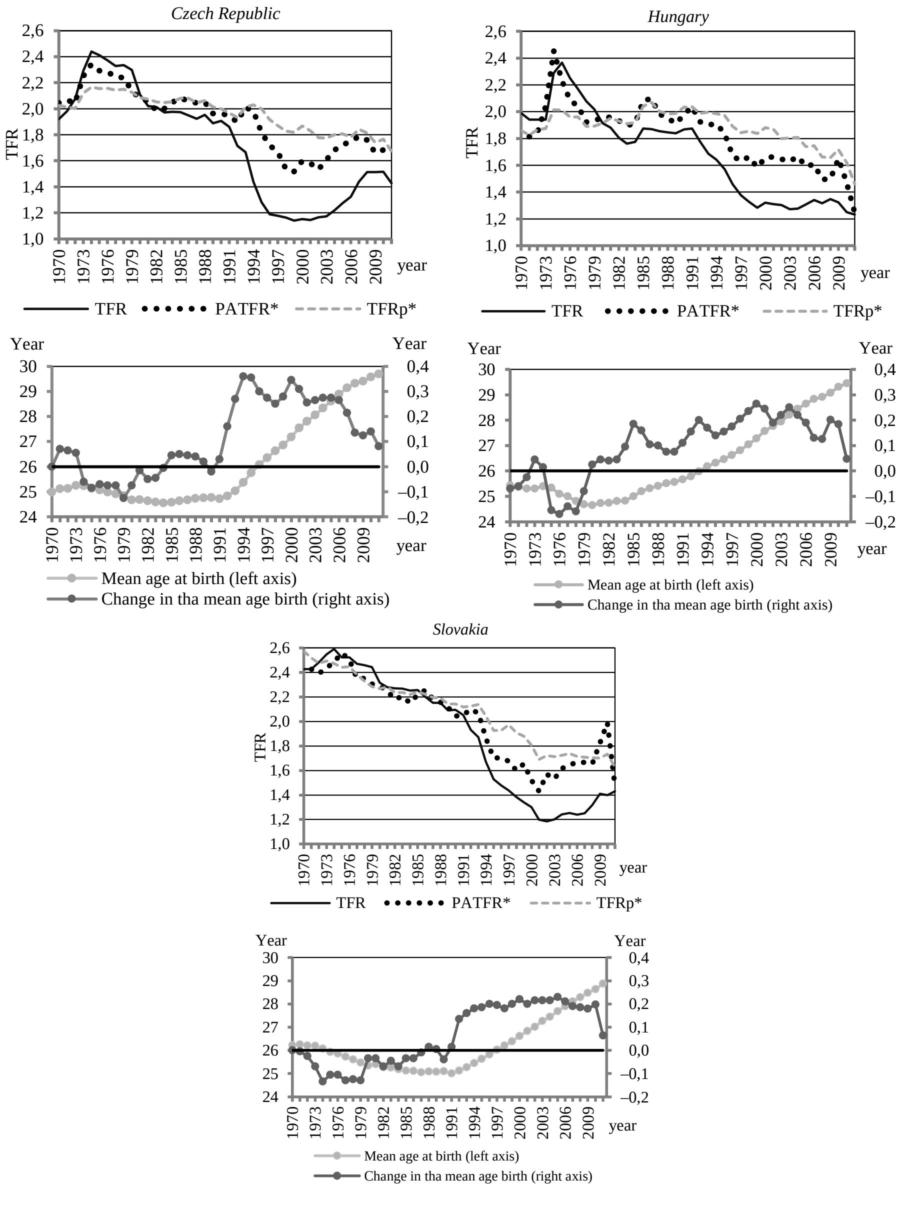
The lower graphs of Figure 1 illustrate that the MAB began to increase in/around that year, when the curve of the TFR fell below that of the TFRp* and PATFR*. This suggests that the decline in TFR was not only caused by the definite decrease in the number of children but also by the postponed childbearing of mothers. Since *Ryder* [1956] first dealt with the postponement of childbearing, this phenomenon has become one of the most often analysed topics in literature (*Bongaarts–Feeney* [1998], *Kohler–Philipov* [2001], *Kohler–Billari–Ortega* [2002], *Ortega–Kohler* [2002], *Sobotka* [2004a], *Husz* [2006], *Goldstein–Sobotka–Jasilioniene* [2009], *Frejka et al*. [2011], *Sobotka–Lutz* [2011], *Bongaarts–Sobotka* [2012], *Myrskylä–Goldstein–Yenhsin* [2013], *Berde–Németh* [2014]). The crucial role of the MAB in Hungary is addressed by one of the studies of *Berde–Németh* [2014], where the estimated linear regression between the increase of the MAB and the TFR for the first parity has yielded a very high multiple correlation coefficient ($R^2 = 0.745$). Strong linear regression was also shown by *Bongaarts–Sobotka* [2012] for the Czech Republic between 1970 and 2008.

If we analyse the connection between the TFRp* and PATFR*, we can see that the latter is higher than the TFRp* in (most) years when the TFR is the greatest among the three period fertility indicators – with a few exceptions, as we have already mentioned. Its explanation may be found in the way the PATFR* is constructed. If the PATFR* has a low (high) value for a certain parity, it stays low (high) for the next parity too, because in the fertility table only those women can bear a second child, who have already born their first, and those who have born the second can have the third, and so on. On the contrary, TFRp* values for different parities are more independent from each other, because the TFRp* relates, for example, the number of second children to all women without two children (i.e. with no child or with one child) in a given age group, and so on. Due to this method, biases in the "same direction" are not cumulated.

[7] MAB: the mean age of women at birth.

[8] The change of the MAB in a given year is the difference between the subsequent year's MAB and the previous year's MAB divided by two (*Bongaarts–Feeney* [1998]).

Figure 1. TFR, PATFR, TFRp* (upper graphs), MAB and its change (lower graphs) in the Czech Republic, Hungary and Slovakia, 1970–2011*



Source: Here and hereinafter, raw data were obtained from the *Human Fertility Database* [2014] with the exception of 2011 Czech data, (*Czech Statistical Office* [2013]), 2010–2011 Hungarian data (*Hungarian Statistical Office* [2010], [2011], [2012]) and 2010–2011 Slovak data (*Statistical Office of the Slovak Republic* [2010], [2011], [2012]). The adjusted fertility rates are our own calculation based on the methodology described by *Jasilione et al*. [2012].

Each fertility indicator shall give an answer to the following question: How many babies are expected on average from a woman of reproductive age over her entire life course? Based on Figure 1, the answer, with respect to the three countries, is: in the 2000s fewer and fewer babies. The relative decrease in the Czech Republic was slightly smaller than in the other two, and at the end of the period analysed the steepest decline was experienced in Hungary. Since 1995, the values of the countries' two tempo- and parity-adjusted indicators have been below 2.1 regarded as the replacement fertility level in modern market economies (*Chesnais* [2000], *Sobotka* [2004b]).

The consequences of the delayed economic crisis in the 2000s could be one of the reasons for the fertility rates decrease (*Bongaarts–Sobotka* [2012], *VID* [2012], *Goldstein et al*. [2013], *Berde–Németh* [2014]), but it is evident that the tendency of MAB changes had to be among the causes, too. (See Figure 1.) At the end of the period, increase of the MAB slowed down, probably because women, owing to their postponing behaviour, almost reached the end of their reproductive life course. Thus, they can/could no longer delay their parenthood if they have/had wished to give life to more than one child. Further research is needed to explain the situation, but the fact is evident: the hope for the positive change in fertility trends is completely vain in the three countries. The slight increase in the TFR experienced in the previous decade is a result of the slowing postponement of childbirths, and does not mean real increase in the number of children women have during their life. Therefore, politicians should continue to be preoccupied with the decreasing size of the populations.

The adjusted period fertility indicators show the real fertility quantum more accurately than the traditional TFR. But how much more? In addition, which of the two tempo- and parity-adjusted total fertility rates performs better? Hindsight, after the reproductive lifespan of women, of course, we can find out the value of CFR in countries where the statistical recording of population fertility is well developed. (See *Human Fertility Database* [2014].) Still, it is not easy to answer the former questions because we have to decide which fertility measures will be compared; and the method of evaluation raises some problems, too. In the next chapter, however, we recommend a method to provide answers and compare CFRs with the tempo- and parity-adjusted period fertility indicators.

2. Difference between various fertility rates

When women of a cohort finish their fertile life – presuming the country has accurate fertility records[9] –, we can calculate the "real" fertility rate of that cohort, i.e. CFR. This indicator, however, does not help policy-makers introduce the best measures to increase (or decrease) the number of children to be born, because at the time of its construction it is already too late to intervene. The CFR describes what happened in the past but cannot indicate what to do, and the benefits from its usage in modelling future developments by different scenarios are limited. However, it provides indirect help in describing and evaluating the actual situation. If we compare the CFR with period fertility indicators calculated upon cross-sectional data of a given year, we can conclude which period fertility must be used to get the closest value to the real fertility rate.

In times when there are not any significant changes in the structure of the female population – regarding different features of childbearing, such as parity, age of mothers, mortality, migration, etc. –, the TFR and the two parity- and tempo-adjusted period fertility rates predict accurately the average number of children a mother would have. However, when something changes in the structural composition, the undistorted fertility rate must be controlled for this change as TFRp* and PATFR* do. Both of these indicators take into consideration the parity composition of mothers (the number of their children) in the year observed and make corrections for the change in the mean age at birth, i.e. for the tempo effect. The construction of the two adjusted indicators differs (see *Bongaarts–Feeney* [1998] p. 278. Equation /3/ and *Kohler–Philipov* [2001] p. 8. Equation /11/), so their values are not equal. (See Figure 1.) Until the second third of the 1980s, the TFRp* and PATFR* values were quite close to each other in the three countries, and in that relatively "quiet" period, large changes of the MAB were not observed either. (See lower graphs of Figure 1.) Then, in the last third of the 1980s, a steep TFR[10] fall and rise in the MAB were recorded, and the difference between the TFRp* and PATFR* values became larger and larger. The difference began to diminish only from the second half of the 2000s.

To find out which adjusted fertility indicator performs better, we have compared the TFRp* and the PATFR* with the CFR, in accordance with the techniques published in literature (*Bongaarts–Sobotka* [2012], *Sobotka* [2003b], *Caselli–Vallin–Wunsch* [2006], *Myrskylä–Goldstein–Yenhsin* [2013]). Note, however, that all types of total fertility rates hide changes in parity fertility rates, when positive and negative

[9] The *Human Fertility Database* [2014] contains suitable Czech and Slovak data from 1935 and Hungarian figures from 1937.

[10] Compared to Western European countries, this late, accelerated decrease in TFR was experienced in many other former communist countries, too, such as Estonia, Latvia, Lithuania, Poland, Russia, Slovenia, and Ukraine (*Eurostat* [2014], *Goldstein–Sobotka–Jasilioniene* [2009]).

differences level each other off and disguise some important changes in the fertility behaviour of women. To sidestep this contradiction, it is worth using parity fertility rates whose sum equals the TFR. Our methods can be illustrated by the example of the female cohort born in 1955. In Hungary, the mean age of women belonging to this cohort was 22.63 at the birth of their first child (*Human Fertility Database* [2014]). We can examine the differences between their first-parity CFR and period fertility rates from 1978 (given by rounding 1955+22.63≈1978). For the comparison, we should find a cohort for every year for which the mean age at birth of the first child is equal to that certain year. However, some years may exist, when no such cohort can be found. In these cases, we average the first-parity CFRs of the previous and next years.

We have carried out this comparison only for the first, second and third birth orders because higher orders represent only a negligible part of the fertility rates in each of the three countries (*Goldstein–Sobotka–Jasilioniene* [2009], *Kapitány–Spéder* [2012]). The comparison can be performed until the year for which we have the latest CFR for the first parity. For example, if we want to calculate the fertility rate for 2003 and assume that the cohort who obtained the MAB for the first birth order in 2003 was born in 1973, we should wait until 2023, because the end of women's reproductive life is 50 years of age in current statistics.

If only the second- and third-parity CFRs are taken into account, and the cohort that obtained the MAB for the second birth order in 2003 was estimated to be born in 1970, we should wait until 2020 to find out real data. (This means three years less compared to 2023.) The "good news" is that due to their calculation methods, there are only small differences between the first-parity PATFR* and TFRp*. (See Table 1.) Therefore, only the comparison of second- and third-parity indicators could give an accurate picture as to which type of fertility rates performs better.

Moreover, if we are interested in the number of births given by women under 40 (the age until almost all births are given), the waiting period can be further reduced. (To find out real data, for example, in the case of the second births of the previous example, we should have only waited until 2010.) Unfortunately collecting and elaborating data take time, which also extends slightly the waiting period.

First we have made a comparison for the relatively quiet period of 1978–1987, when the MAB remained comparatively stable, neither significant increase nor decrease occurred, and no great differences were found between PATFR* and TFRp* values. (See Figure 1.) Since there were only small differences between the three countries in their same-parity MABs, we used slightly different cohorts for each of them.[11] Since the values of the period fertility indicators in a single year

[11] First parity: the Czech Republic – 1956–1965 cohort; Hungary and Slovakia – 1955–1964 cohort. Second parity: Hungary – 1952–1961 cohort; the Czech Republic and Slovakia – 1953–1962 cohort. Third parity: Czech Republic and Slovakia – 1950–1959 cohort, Hungary 1949–1958 cohort.

depend greatly on occasional events, to exclude uncertainty, we have calculated a five-year moving average for the TFRp* and PATFR*. (A similar method of excluding random noise was used by *Bongaarts–Sobotka* [2012], too.) Table 1 shows the results of comparison and Figure 2 presents the graphs of the three indicators.

Table 1

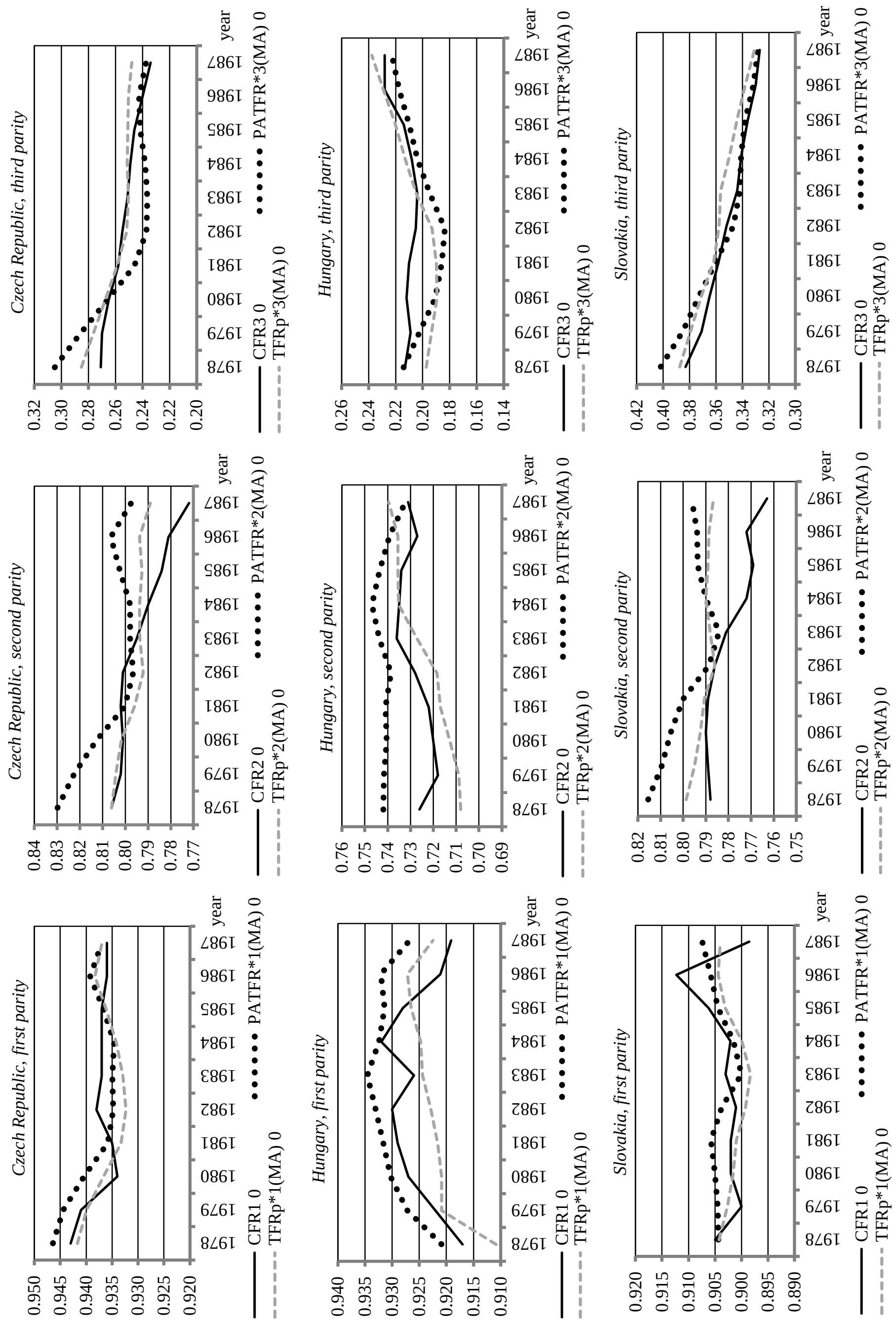
Averages of the absolute values of differences between CFR and PATFR and between CFR and TFRp* by parity, 1978–1987*

Country/Average	Difference	First parity	Second parity	Third parity
Czech Republic	CFR – PATFR*(MA)	0.002634	0.014209	0.011643
	CFR – TFRp*(MA)	0.002354	0.006138	0.005925
Hungary	CFR – PATFR*(MA)	0.005154	0.013206	0.010781
	CFR – TFRp*(MA)	0.004379	0.007687	0.010775
Slovakia	CFR – PATFR*(MA)	0.004837	0.017752	0.005480
	CFR – TFRp*(MA)	0.003879	0.010610	0.006977
Average of per-country differences	CFR – PATFR*(MA)	0.004208	0.015056	0.009301
	CFR – TFRp*(MA)	0.003537	0.008145	0.007892

Note. Here and hereinafter, MA stands for moving average.

According to Table 1, the differences between CFR and TFRp* are smaller than between CFR and PATFR* for every parity. This means that in peaceful times, when there are not big changes in fertility trends (as the 1978–1987 period was in the three countries), the Boongarts–Feeney tempo- and parity-adjusted period fertility rate (TFRp*) performs better than the Kohler–Ortega indicator (PATFR*). Again, it is worthy to note that the differences for the second and third parities are greater than the differences for the first parity because TFRp* and PATFR* values for various birth orders are added together. Thus, these total period fertility indicators are very sensitive to the components of the second and third birth orders. Table 1 also illustrates that the PATFR* is less reliable than the TFRp*. The great sensitivity of the PATFR* may be due to how it is constructed: fertility tables inherit biases from lower to higher parities. On the contrary, calculation of the TFRp* for a higher birth order does not rely on the results of the lower one(s), so previous errors are not passed on.

Figure 2. PATFR, TFRP* and CFR by parity, 1978–1987*



The accuracy of period fertility indicators is much crucial in periods when the fertility trend and the structure of the female population are changing (for example, when childbearing is postponed compared to stable periods), as it was the case between 1993 and 1997 in the three countries. (Although the change was intense between 1988 and 1992, it did not reach the level of 1993–1997.) After 1997 the transition continued. CFR values, however, do not exist for this late period (neither for the first parity from 1993 to 1997 nor for the whole reproductive period of women regarding the second and third birth orders). Therefore, we could have used the CFR for the second and third birth orders taking the latest available year into consideration (just like *Boongarts–Sobotka* [2012]) and substituted the missing cohort fertility data of an older age group with the actual period fertility rates of the same age group. Instead, we have used the CFR and calculated the PATFR* and TFRp* until 40 years of age. In some cases, it was impossible to find a cohort whose MAB for the second and third children belonged to the 1993–1997 period. In these cases, the average CFR40 of the two adjacent cohorts were taken, the MAB of which was just before and after the relevant year.

Table 2 presents the results of the comparison, and Figure 3 shows the trends of the three indicators.

Table 2

*Averages of the absolute values of differences between CFR40 and PATFR*40 and between CFR40 and TFRp*40 by the second and third parities, 1993–1997*

Country/Average	Difference	Second parity	Third parity
Czech Republic	CFR40 – PATFR*40(MA)	0.038392	0.051421
	CFR40 – TFRp*40(MA)	0.037999	0.014328
Hungary	CFR40 – PATFR*40(MA)	0.038559	0.060083
	CFR40 – TFRp*40(MA)	0.017378	0.006381
Slovakia	CFR40 – PATFR*40(MA)	0.031766	0.063525
	CFR40 – TFRp*40(MA)	0.003918	0.016633
Average of per-country differences	CFR40 – PATFR*40(MA)	0.036239	0.058343
	CFR40 – TFRp*40(MA)	0.019765	0.012447

Note. 40: only data of 40-year-old and younger women are taken into consideration.

*Figure 3. CFR40, PATFR*40, and TFRp*40 by parity, 1993–1997*

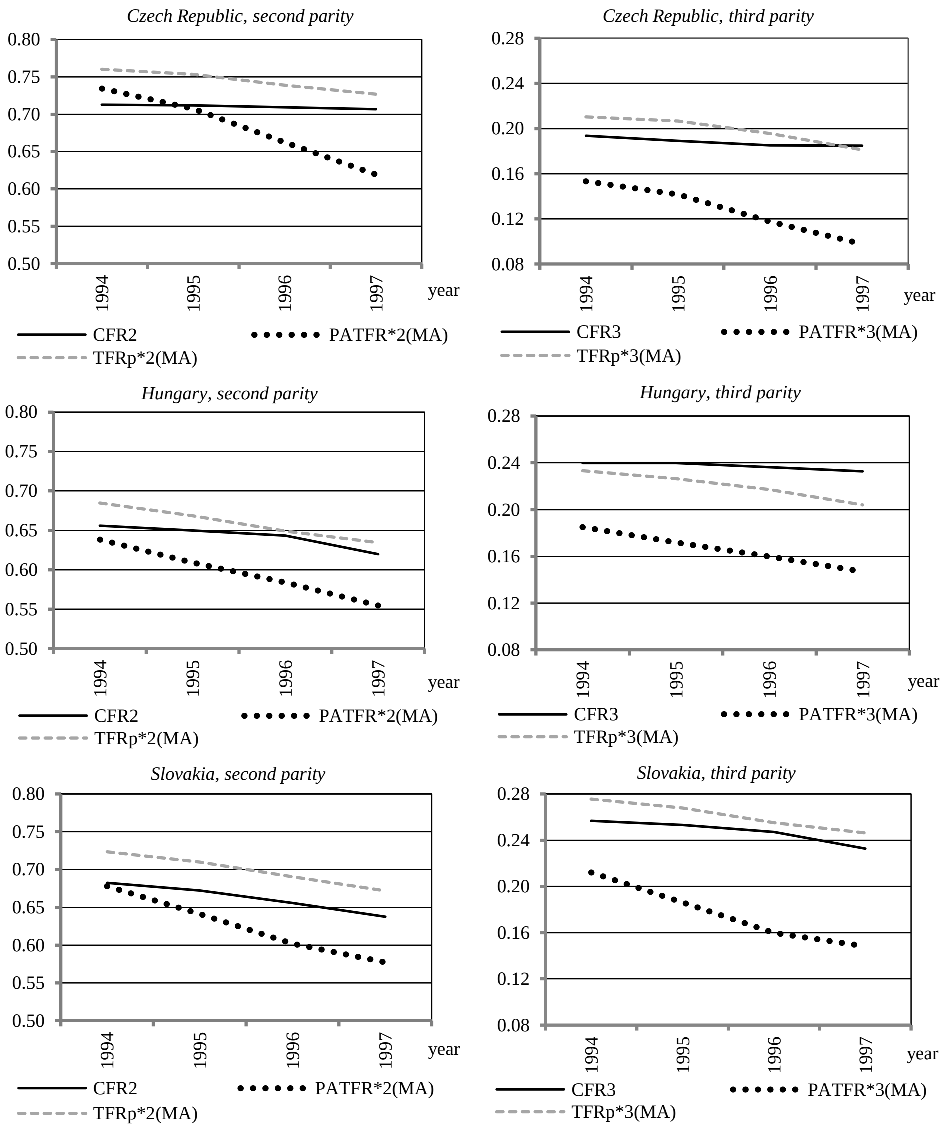
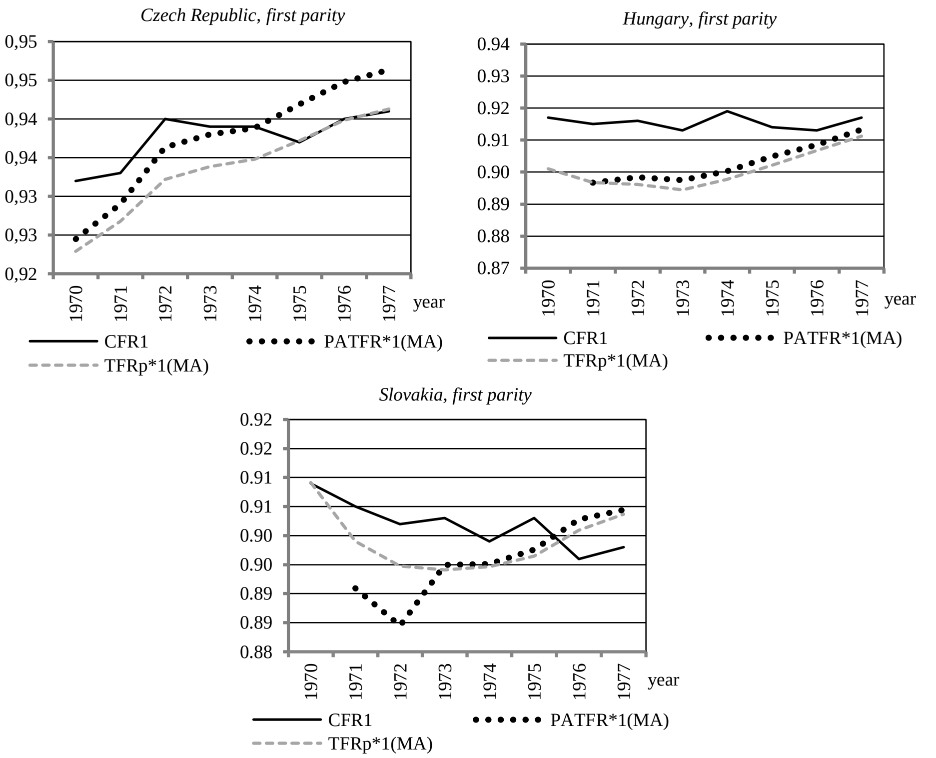


Table 2 and Figure 3 illustrate that the TFRP*40 for both the second and third birth orders is closer to the CFR40 than the PATFR*40 in each country. The average of the differences of the CFR40 and TFRp*40 is about 55% of that of the CFR40 and PATFR*40 as for the second parity, and only about 20% regarding the third parity. The results reveal that the TFRp* performs generally better than the PATFR*. (See

Tables 1 and 2.) However, the differences in Table 2 are greater than in Table 1, which refers to the fact that the TFRp* cannot indicate the exact fertility rate either when the structure of the female population changes. Therefore, further research is needed to discover what corrections should be made to improve the accuracy of these fertility indicators.

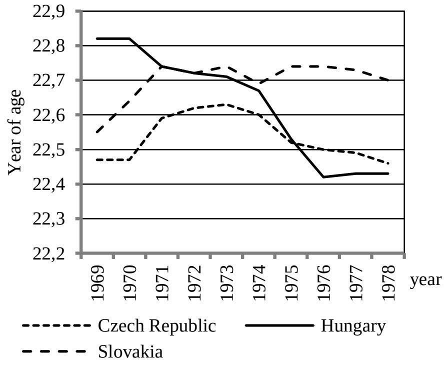
Based on the aforementioned, one may think that the TFRp* always performs better than the PATFR*. To demonstrate that the assumption is not always true, we have also examined the 1970–1977 period (when the MAB was decreasing (with a few exceptions)), and calculated the CFR by the same method used previously. The findings are controversial. (See Figure 4.)

Figure 4. CFR, PATFR and TFRp* by first parity, 1970–1977*



In the 1970–1977 period the PATFR* performed better than the TFRp* for the first parity both in the Czech Republic and Hungary, but in Slovakia the TFRp* had the best results. These findings can be explained by the mean age of women at the birth of their first child. (See Figure 5.)

Figure 5. Mean age of women at the birth of their first child, 1969–1978



In Figure 5, the MAB shows a continuously decreasing trend for Hungary, first rises then falls in the Czech Republic, and after an initial increase remains almost constant in Slovakia. Changes in the MAB have a crucial role in the correction factor of both adjusted period fertility rates. Generally, if the MAB grows, the original fertility number is increased by correction, whereas a falling MAB lowers the corrected fertility rate, too. The correction in the case of the PATFR* depends on the age of mothers and the standard deviation of the childbearing age, but as for the TFRp*, the correction factor is the same for all ages. When the MAB rises, the factor helps to reveal the real fertility rate of younger generations and does not have a strong effect on the older one(s), where fertility numbers are low. However, when the MAB falls, the TFRp*value for younger generations is distorted due to correction, which is either negligible or can raise the value of the indicator in the case of the PATFR*. According to our results, when the MAB increases, the TFRp* performs better, but when it decreases, the PATFR* is more convenient at least for the first parity. Table 3 shows, however, that these conclusions are disputable in the cases of higher birth orders. Despite the fact that the MAB values for the second and third births have very similar tendencies to those for the first birth, the TFRp* gives better results in each of the three countries for the second and third parities.

Table 3

Averages of the absolute values of differences between CFR and PATFR and between CFR and TFRp* by parity, 1970–1977*

Country/Average	Difference	First parity	Second parity	Third parity
Czech Republic	CFR – PATFR*(MA)	0.003918	0.020410	0.054809
	CFR – TFRp*(MA)	0.004147	0.012946	0.022726
Hungary	CFR – PATFR*(MA)	0.012500	0.029060	0.049782
	CFR – TFRp*(MA)	0.014559	0.018155	0.017444
Slovakia	CFR – PATFR*(MA)	0.008869	0.018897	0.024957
	CFR – TFRp*(MA)	0.006231	0.007261	0.01509
Average of per-country differences	CFR – PATFR*(MA)	0.008429	0.022789	0.043183
	CFR – TFRp*(MA)	0.008312	0.012787	0.018420

As our results show, there is not a straightforward rule to determine which of the two tempo- and parity-adjusted period indicators performs better under all circumstances. Table 4 summarizes the strengths, weaknesses, opportunities and threats of these measures given by SWOT analysis, a widely used tool in economics.

Table 4

SWOT analysis of the two tempo- and parity-adjusted fertility indicators

Strengths	Weaknesses	Opportunities	Threats
TFRp*			
It is more precise than the PATFR* when childbearing is postponed.	It can show a false picture when the MAB decreases.	Its performance could be improved by incorporating the mothers' age into the correction factor.	It is not correct if the postponement of childbearing is reversed.
PATFR*			
In addition to MAB correction, it also depends on the mothers' age and the standard deviation of childbearing age.	The calculation-related bias regarding a certain parity is passed onto higher birth orders.	It can be used instead of the TFRp* when the MAB continuously decreases.	The fertility table brings too much rigidity into calculation.

In spite of the drawbacks included in Table 4, we still recommend the usage of these adjusted fertility indicators (instead of the TFR) when large changes in the structure of the female population occur. In the periods of childbearing postponement, especially the TFRp* is useful. Nevertheless, when the MAB is steadily declining (what rarely happens nowadays), further investigation is needed before choosing the calculation method of period fertility rates.

3. Conclusions

In this paper, we have analysed the fertility trends in three adjacent Central-European countries (the Czech Republic, Hungary and Slovakia) between 1970 and 2011. These countries have a similar history, thus, it is not surprising that they are much alike regarding the number of children and the women's age at childbirth. The general tendency was the continuous decrease of fertility rates in all three countries, with a few, short, exceptional periods and with a steeper decrease at the very end of the time interval examined.

In the 2000s, only looking at the traditional TFR, some policy-makers recognized mistakenly a reversal or recovery in the fertility trends of the three countries. However, by studying the adjusted fertility rates, we have found that the quantum factor of fertility had further decreased. Contrary to some Western European countries, there is no sign of increasing fertility rates. Still, the fertility trend is not lowering unambiguously as might be thought using only TFRs. Although the postponement of childbearing from the beginning of the first third of the 1980s has accelerated and resulted in the "lowest low" TFR (*Kohler–Billari–Ortega* [2002], *Sobotka* [2004b]), if the whole reproductive period is considered, women still give birth to more children according to the Bongaarts–Feeney TFRp* and Kohler–Ortega PATFR* than the TFR forecasts. Nevertheless, the steep fall of fertility rates at the end of the period analysed may be a signal of radical decrease in childbearing intentions.

In addition to comparing and evaluating the Czech, Hungarian and Slovak fertility behaviour, we have also aimed to judge the performance of various adjusted fertility rates. For both the TFRp* and PATFR*, we have taken into consideration the parity distribution of the female population in the year of observation and control for the expected timing of childbirths, i.e. use tempo correction. After women finished their reproductive period, the observed CFR can be used to find out which of the corrected period fertility indicators performs better. Although the CFR gives information on fertility "relatively late", it still proves to be an effective tool for evaluating the accuracy of fertility rates calculated for previous years. We also explained in detail how it can be compared with the TFRp* and PATFR*.

The tempo correction of the PATFR* is more sophisticated and avoids the undervaluation of the fertility rate in times when the MAB decreases. However, this advantage is counterbalanced by frequent errors owing to the way it is constructed. When calculating the PATFR*, we use fertility tables for women, where a distortion in the rate at a certain birth order is passed on to subsequent birth orders, leading to a false result. The TFRp* avoids this problem by treating each parity independently, and in most of the cases it performs better than the PATFR*. Based on the findings, we suggest the general usage of the TFRp*, when the MAB does not show a permanently decreasing trend (which shall be the subject of further consideration). We are intending to continue the research to find a more sophisticated method of correcting the traditional fertility rate.

Appendix

PATFR and TFRp* in the Czech Republic, Hungary and Slovakia, 1970–2011*

Year	PATFR*			TFRp*		
	Czech Republic	Hungary	Slovakia	Czech Republic	Hungary	Slovakia
1970	2.046	1.839	2.474	2.026	1.860	2.574
1971	2.068	1.813	2.427	2.013	1.844	2.518
1972	2.041	1.846	2.393	2.001	1.867	2.475
1973	2.259	2.038	2.435	2.120	1.893	2.494
1974	2.363	2.454	2.485	2.167	2.069	2.474
1975	2.305	2.232	2.559	2.154	2.066	2.441
1976	2.279	2.085	2.505	2.158	1.996	2.447
1977	2.234	2.041	2.353	2.144	1.961	2.381
1978	2.243	1.922	2.350	2.151	1.890	2.330
1979	2.142	1.935	2.305	2.126	1.892	2.284
1980	2.079	1.952	2.290	2.086	1.914	2.268
1981	2.053	1.960	2.249	2.074	1.952	2.281
1982	1.986	1.933	2.181	2.054	1.929	2.236
1983	2.001	1.898	2.206	2.049	1.910	2.237
1984	2.049	1.911	2.152	2.053	1.919	2.220
1985	2.084	2.085	2.218	2.080	2.040	2.242
1986	2.057	2.096	2.255	2.080	2.069	2.224
1987	2.044	1.983	2.185	2.047	2.004	2.195

(Continued on the next page.)

(Continuation.)

Year	PATFR*			TFRp*		
	Czech Republic	Hungary	Slovakia	Czech Republic	Hungary	Slovakia
1988	2.050	1.954	2.158	2.061	1.983	2.191
1989	1.963	1.911	2.114	2.014	1.988	2.142
1990	1.967	1.978	2.044	2.001	2.034	2.143
1991	1.945	2.037	2.052	1.967	2.037	2.117
1992	1.900	1.924	2.101	1.932	1.988	2.125
1993	2.013	1.903	2.068	2.013	1.996	2.137
1994	1.980	1.910	1.861	2.029	1.986	2.044
1995	1.814	1.838	1.703	2.001	1.972	1.926
1996	1.719	1.670	1.703	1.915	1.891	1.927
1997	1.666	1.632	1.675	1.870	1.844	1.973
1998	1.533	1.664	1.600	1.828	1.855	1.909
1999	1.517	1.585	1.655	1.819	1.837	1.879
2000	1.599	1.656	1.518	1.869	1.880	1.806
2001	1.581	1.663	1.430	1.831	1.868	1.690
2002	1.532	1.645	1.571	1.776	1.800	1.722
2003	1.610	1.630	1.530	1.774	1.804	1.714
2004	1.683	1.664	1.617	1.801	1.808	1.725
2005	1.723	1.591	1.645	1.807	1.740	1.739
2006	1.752	1.607	1.667	1.782	1.747	1.715
2007	1.788	1.494	1.666	1.842	1.661	1.709
2008	1.760	1.498	1.656	1.815	1.658	1.704
2009	1.663	1.650	1.822	1.739	1.718	1.702
2010	1.684	1.470	1.989	1.767	1.620	1.734
2011	1.682	1.243	1.461	1.673	1.461	1.626

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